TECHNICAL REPORT RD-TM-98-2

TACTICAL UNMANNED VEHICLE (TUV) USER APPRAISAL PHASE I

Walter L. Diveley
Unmanned Ground Vehicles/
Systems Joint Project Office
U. S. Army Aviation and Missile Command

October 1998

U.S. ARMY AVIATION AND MISSILE COMMAND
Redstone Arsenal, Alabama 35898-5000

Approved for Public Release. Distribution is unlimited.

DESTRUCTION NOTICE

FOR CLASSIFIED DOCUMENTS, FOLLOW THE PROCEDURES IN DoD 5200.22-M, INDUSTRIAL SECURITY MANUAL, SECTION II-19 OR DoD 5200.1-R, INFORMATION SECURITY PROGRAM REGULATION, CHAPTER IX. FOR UNCLASSIFIED, LIMITED DOCUMENTS, DESTROY BY ANY METHOD THAT WILL PREVENT DISCLOSURE OF CONTENTS OR RECONSTRUCTION OF THE DOCUMENT.

DISCLAIMER

THE FINDINGS IN THIS REPORT ARE NOT TO BE CONSTRUED AS AN OFFICIAL DEPARTMENT OF THE ARMY POSITION UNLESS SO DESIGNATED BY OTHER AUTHORIZED DOCUMENTS.

TRADE NAMES

USE OF TRADE NAMES OR MANUFACTURERS IN THIS REPORT DOES NOT CONSTITUTE AN OFFICIAL ENDORSEMENT OR APPROVAL OF THE USE OF SUCH COMMERCIAL HARDWARE OR SOFTWARE.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 074-0188

1. AGENCY USE ONLY	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	October 1998	Final

4. TITLE AND SUBTITLE
Tactical Unmanned Vehicle (TUV) User Appraisal Phase I

5. FUNDING NUMBERS

6. AUTHOR(S)
Walter L. Diveley

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

Commander, U. S. Army Aviation and Missile Command
Missile, Research, Development, and Engineering Center
ATTN: AMSAM-DSA-UG
Redstone Arsenal, AL 35898-5000

8. PERFORMING ORGANIZATION REPORT NUMBER

TR-RD-TM-98-2

9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)

10. SPONSORING / MONITORING AGENCY REPORT NUMBER

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT
Approved for public release; Distribution is unlimited.

12b. DISTRIBUTION CODE

A

13. ABSTRACT *(Maximum 200 Words)*

In June 1996, a Memorandum of Agreement (MOA) was signed between the Unmanned Ground Vehicles/Systems Joint Project Office (UGV/S JPO), 3de Brigrade, 3d Infantry Division (Mechanized), and the 2-69 Armor Battalion to conduct the Tactical Unmanned Vehicle (TUV) User Appraisal. In January 1997, after preliminary training, four Surveillance and Reconnaissance Ground Equipment (SARGE) systems were handed-off to the 2-69 Armor Battalion scout platoon. A fifth SARGE system was designated to the User Appraisal maintenance float. However, while at the Aberdeen Test Center undergoing testing, the fifth SARGE system was completely destroyed in a warehouse fire. The JPO made the decision to continue the User Appraisal with only four systems and forego the use of a maintenance float. The remaining available system was left at the U. S. Army Aviation and Missile Command (USAAMCOM) Missile Research, Development, and Engineering Center's (MRDEC) Robotic Integration Laboratory (RIL). This system was used to incorporate system reliability and performance improvements requested by the scout platoon.

14. SUBJECT TERMS
Surveillance and Reconnaissance Ground Equipment (SARGE), Tactical Unmanned Vehicle (TUV), User Appraisal

15. NUMBER OF PAGES
46

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UNCLASSIFIED	UNCLASSIFIED	UNCLASSIFIED	UNLIMITED

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. Z39-18
298-102

EXECUTIVE SUMMARY

In June 1996, a Memorandum of Agreement was signed between the Unmanned Ground Vehicles/Systems Joint Project Office (UGV/S JPO), 3de Brigade, 3d Infantry Division (Mechanized), and the 2-69 Armor Battalion to conduct the Tactical Unmanned Vehicle (TUV) User Appraisal. In January 1997, after preliminary training, four Surveillance and Reconnaissance Ground Equipment (SARGE) systems were handed-off to the 2-69 Armor Battalion scout platoon.

The UGV/S JPO defined five objectives for the TUV User Appraisal:

- Develop a set of TUV tactics, techniques, and procedures (TTP).

- Make recommendations for changes to the TUV Operational Requirements Document (ORD) based on user feedback.

- Make recommendations for changes to the TUV system performance specification based on user feedback.

- Make system design changes to improve the reliability, maintainability, and operational performance of the SARGE system based on user feedback.

- Gain insights into the potential operational effectiveness of the TUV equipped scout platoon and battalion based on user feedback.

The TUV User Appraisal Phase I achieved all its stated objectives. Placing a prototype TUV in an armor battalion scout platoon for a six-month appraisal enabled the UGV/S JPO to collect critical soldier feedback on TUV operational and system performance requirements; man-machine interface requirements; TUV tactical communication requirements; TUV mission planning hardware and software requirements; and TUV tactics, techniques, and procedures (TTPs).

Key results of TUV User Appraisal Phase I are listed in the Summary on page 37 of this document. The success of the User Appraisal is best summed up by the user. In an interview with the Army Science Board (ASB), the 2-69 Armor Battalion scout platoon endorsed the TUV concept and stated that from their use of a prototype TUV, the fielded TUV will increase the scout platoon's survivability, increase the number of areas it can be

tasked to observe, expand the distance it can conduct reconnaissance without concern for indirect fire support from its battalion, and increase the operational effectiveness of its parent battalion. The scout platoon also told the ASB that the Army and Marine Corps should continue efforts to field the TUV.

C.K. Curcio

COL C.K. Curcio
Project Manager
Unmanned Ground Vehicles/
Systems Joint Project Office

Richard M. Dunnigan

LTC Richard M. Dunnigan
Product Manager
Tactical Unmanned Vehicle
Unmanned Ground Vehicles/
Systems Joint Project Office

Walter L. Diveley

MAJ Walter L. Diveley
Assistant Project Manager
Tactical Unmanned Vehicle
User Appraisals
Unmanned Ground Vehicles/
Systems Joint Project Office

TABLE OF CONTENTS

		Page
I.	BACKGROUND	1
II.	SARGE VEHICLE SYSTEM DESIGN CHANGES PRIOR TO USER APPRAISALS	1
III.	SARGE SYSTEM TESTING	3
IV.	USER APPRAISAL PURPOSE AND OBJECTIVES	3
V.	USER APPRAISAL APPROACH	4
VI.	TUV SARGE USER APPRAISAL TEAM	5
	A. User Appraisal Team Forward	5
	B. User Appraisal Redstone	5
VII.	SARGE SYSTEM DESCRIPTION	6
	A. Remotely Controlled Multimission Platform (RCMMP)	6
	B. OCR	7
	C. STH	7
	D. Mission Planner	9
	E. SINCGARS and Intercom System	9
	F. Pendant	9
	G. Generator	10
	H. Battery Charger	10
	I. OCR Power Converter	11
VIII.	SCOUT PLATOON ORGANIZATION	12
IX.	TUV (SARGE) USER APPRAISAL TRAINING	12
	A. JANUS Training	12
	B. TUV (SARGE) Scout Platoon Leadership Operation and Maintance Training	13
	C. Scout Platoon TUV (SARGE) Training	13
	D. Scout Platoon Lane Training	14
	E. Scout (SARGE) Desert Training	15

TABLE OF CONTENTS (CONT.)

		Page
X.	MAINTENANCE AND LOGISTICS SUPPORT	16
	A. Maintance	16
	B. Logistics	18
XI.	FREQUENCY MANAGEMENT	19
	A. Discussion	19
	B. Recommendation	19
XII.	USER APPRAISAL CONTRACTING	20
XIII.	TACTICS, TECHNIQUES, AND PROCEDURES (TTP)	21
	A. Mission Essential Task 1. Prepare for Combat/Conduct Sustainment Operation	21
	B. Mission Essential Task 2. Perform Reconnaissance Mission	21
	C. Mission Essential Task 3. Perform Passage of Lines	23
	D. Scout Platoon's Summary on the SARGE System	23
XIV.	KEY LESSONS LEARNED	24
	A. TUV Operational Effectiveness	24
	B. TUV RF Communications Link	25
	C. Operation Control Unit (OCU)	25
	D. Remotely Controlled Multi-Mission Mobile Platform (RCMU)	29
	E. Driving and Targeting Sensors	30
XV.	SUMMARY	36

LIST OF ILLUSTRATIONS

Figure	Title	Page
1.	Remotely Controlled Multimission Platform (RCMMP)	6
2.	Operator Control Unit (OCU)	7
3.	SARGE Transport HMMWV (STH)	8
4.	OCU/Mission Planning Work-Station (Rear of STH)	8
5.	Mission Planner	9
6.	Pendant	10
7.	Generator	10
8.	Battery Charger	11
9.	OCU Power Converter	11

I. BACKGROUND

In June 1996, a Memorandum of Agreement (MOA) was signed between the Unmanned Ground Vehicles/Systems Joint Project Office (UGV/S JPO), 3de Brigade, 3d Infantry Division (Mechanized), and the 2-69 Armor Battalion to conduct the Tactical Unmanned Vehicle (TUV) User Appraisal. In January 1997, after preliminary training, four Surveillance and Reconnaissance Ground Equipment (SARGE) systems were handed-off to the 2-69 Armor Battalion scout platoon. A fifth SARGE system was designated to be the User Appraisal maintenance float. However, while at the Aberdeen Test Center undergoing testing, the fifth SARGE system was completely destroyed in a warehouse fire. The JPO made the decision to continue the User Appraisal with only four systems and forego the use of a maintenance float. The remaining available system was left at the U. S. Army Aviation and Missile Command (USAAMCOM) Missile Research, Development, and Engineering Center's (MRDEC) Robotic Integration Laboratory (RIL). This system was used to incorporate system reliability and performance improvements requested by the scout platoon.

II. SARGE VEHICLE SYSTEM DESIGN CHANGES PRIOR TO USER APPRAISALS

The original SARGE vehicle was built by Sandia National Laboratories, Albuquerque, NM, based on their "Dixie" robot. Using reverse-engineering techniques, the USAAMCOM MRDEC RIL designed changes, developed engineering drawings, and provided a fabrication and integration package to the integration/support contractor, SUMMA Technology, Inc. to produce the improved SARGE systems.

Twenty-two system reliability, maintainability, and performance improvements were incorporated into the SARGE design. In June 1996, a two-seater High Mobility Multipurpose Wheeled Vehicle (HMMWV) with an open cargo bed was included in the system as a SARGE Transport HMMWV (STH). The system reliability, maintainability, and performance changes are listed below:

1. Improved limit switch mounting; waterproofed limit switches.
2. Installed sealed steering potentiometers with more rugged wiring.
3. Deleted mast actuator.
4. Replaced servo amplifiers.
5. Redesigned sensor-housing box to accommodate driving and targeting Forward-Looking Infrared (FLIR) sensors, and MELIOS laser range finder.
6. Designed fittings to allow nitrogen purge of sensor box.
7. Redesigned front brake actuator limit switch to increase electrical capacity.
8. Redesigned saddlebags with heavier-gauge metal and improved closure.

9. Ensured watertight integrity of saddlebags.

10. Added engine fan.

11. Installed fuses with increased current capacity on battery chargers.

12. Developed methods to prevent corrosion of pan center-detect ring.

13. Improved communication link to prevent radio dropout; added cooling fan and heat shield to radio box.

14. Optimized location for communication link antennas to minimize interference.

15. Increased size of electronics box under the pan-and-tilt mechanism.

16. Designed power cable to allow Operator Control Unit (OCU) to be powered off HMMWV.

17. Designed cloth shroud for OCU.

18. Installed heavy-duty alternator on SARGE vehicle.

19. Designed new roll-cage.

20. Installed remote driving and night targeting FLIRs

21. Installed MELIOS laser range finder.

22. Designed new pan-and-tilt mechanism to accommodate new sensor housing box.

III. SARGE SYSTEM TESTING

The JPO's Product Assurance, Test, and Configuration Management (PATCM) division conducted 40 hours of burn-in testing on each SARGE system at the UGV/S JPO practice facility prior to delivering the four SARGE systems to the 2-69 Armor Battalion. The USAAMCOM MRDEC RIL and the integration/support contractor provided technical and maintenance support for the testing. Testing proved vital in uncovering reliability problems with the systems, allowing corrections to be made prior to handing the systems off to the User Appraisal battalion.

Additionally, one SARGE system underwent safety, environmental, and vibration testing at the Aberdeen Test Center, Aberdeen Proving Grounds, Maryland. The integration/support contractor provided an on-site maintenance technician to support the safety testing. This testing resulted in a SARGE safety release, allowing the SARGE to be used by soldiers during field training exercises.

IV. USER APPRAISAL PURPOSE AND OBJECTIVES

The UGV/S JPO defined five objectives for the TUV User Appraisal:

- Develop a set of TUV Tactics, Techniques, and Procedures (TTP).
- Make recommendations for changes and additions to the TUV Operational Requirements Document (ORD) based on user feedback.
- Make recommendations for changes and additions to the TUV system performance specification based on user feedback.
- Make system design changes to improve the reliability, maintainability, and operational performance of the SARGE system based on user feedback.
- Gain subjective insights into the potential operational effectiveness of the TUV equipped battalion/scout platoon based on user feedback.

V. USER APPRAISAL APPROACH

The User Appraisal consisted of three key features: (1) To be non-intrusive on the 2-69 Armor Battalion's scheduled training; (2) to improve the performance of the TUV prototype (SARGE) based on feedback from the scout platoon; (3) and to fully fund the User Appraisal resulting in no monetary cost to the User Appraisal unit. These features of the User Appraisal greatly appealed to the 2-69 Armor Battalion leadership and its parent brigade.

The User Appraisal was designed to produce a set of TUV TTP; provide subjective insights into the potential operational effectiveness of the TUV; and provide information on the TUV's system and operational requirements. The process was non-intrusive on the 2-69 Armor scout platoon's training. SARGE system operaton and tactical employment training was scheduled with the battalion. This training did not conflict with the platoon's training schedule. Once trained, the scout platoon used the TUV during previously scheduled field training exercises. The only SARGE-specific field exercise scheduled was the deployment to the Marine Corps Air-Ground Combat Center (MCAGCC), 29 Palms, California, for desert training. Dedicated data collectors were not used, nor were the SARGE systems outfitted with data collecting devices. The two primary methods of data collection were the Army's standard After Action Review (AAR) and questionnaires. The User Appraisal Team Forward made every effort to videotape all of the AARS.

A second key feature of the User Appraisal was the commitment by the JPO to make SARGE system improvements as recommended by the scout platoon. The recommended changes were taken from the scout platoon, evaluated and prioritized, and inserted as modifications into the systems by the USAAMCOM-MRDEC RIL and the integration/support contractor, SUMMA Technology, Inc. Since it was not feasible to make all the recommended changes, the scout platoon was advised on which changes could not be made and why. The approved changes were made to the SARGE systems during non-training periods of the scout platoon's training cycle.

The JPO incurred all costs associated with the User Appraisal process. These costs included: travel, billeting, rental cars, labor, SARGE spare parts, fuel and lubricants, STH spare parts, fuel, and lubricants, shipment of the SARGE systems, and modifications to the SARGE system as requested by the user.

VI. TUV SARGE USER APPRAISAL TEAM

The TUV SARGE User Appraisal Team was divided into two groups: (1) User Appraisal Team Forward, and (2) User Appraisal Team Redstone. These teams consisted of the following personnel:

A. User Appraisal Team Forward

(1) One JPO Army Major serving as the Assistant Product Manager for TUV User Appraisals.

(2) One JPO logistics specialist.

(3) Two contracted SARGE maintenance technicians.

(4) One contracted SARGE engineer.

(5) One SARGE integration/support project manager (contractor).

(6) One software engineer from USAAMCOM Software Engineering Directorate (SED) for mission planner support.

(7) One JPO Systems Engineering and Technical Assistance (SETA) contractor for audiovisual and general support.

(8) Additional contractor personnel as required for SARGE integration and support.

B. User Appraisal Team Redstone

(1) JPO administrative, contracting and technical personnel.

(2) USAAMCOM-MRDEC RIL engineers.

(3) USAAMCOM-MRDEC RIL contractor personnel.

(4) JPO SETA contractor personnel.

VII. SARGE SYSTEM DESCRIPTION

The SARGE system described in this section represents the final SARGE configuration at the completion of the TUV User Appraisal Phase I. Over 90 changes were made to the SARGE system as a result of user feedback. This process assisted the TUV Integrated Product Team (IPT) in preparing the TUV performance specification. It also assisted the Combat Developer in updating the TUV ORD.

The JPO is currently upgrading the SARGE in 22 specific areas to further improve reliability, maintainability, and operational performance. Many of these improvements are based on the feedback from the 2-69 Armor Battalion scout platoon that were not incorporated during the User Appraisal. The current configuration of the SARGE consists of the basic components and associated support equipment described below.

A. Remotely Controlled Multimission Platform (RCMMP)

Except for selected standard military connectors, the RCMMP consists of Commercial Off-The-Shelf (COTS) components. The RCMMP is a gasoline powered, teleoperated vehicle based on a modified, commercial, small All-Terrain Vehicle (ATV) platform (Yamaha Breeze). The RCMMP carries the day and night remote driving sensors for teleoperaton, day and night sensors for Reconnaissance, Surveillance, Target Acquisition (RSTA), compass engine, Global Positioning System (GPS), and an eye-safe laser rangefinder. The RCMMP has a flexible video/Radio Frequency (RF) antenna that allows it to receive commands from and provide system status to the operator at the OCU. The driving sensors allow the operator to remotely drive the RCMMP both day and night f rom the OCU. The RSTA sensors and driving sensors on the RCMMP are housed together in a "RSTA head." Once remotely driven by the operator to its desired location, the RCMMP can be placed into a "quiet" mode, and operate off of battery power. A hand-held pendant attaches to the RCMMP to load and unload the RCMMP f rom the STH.

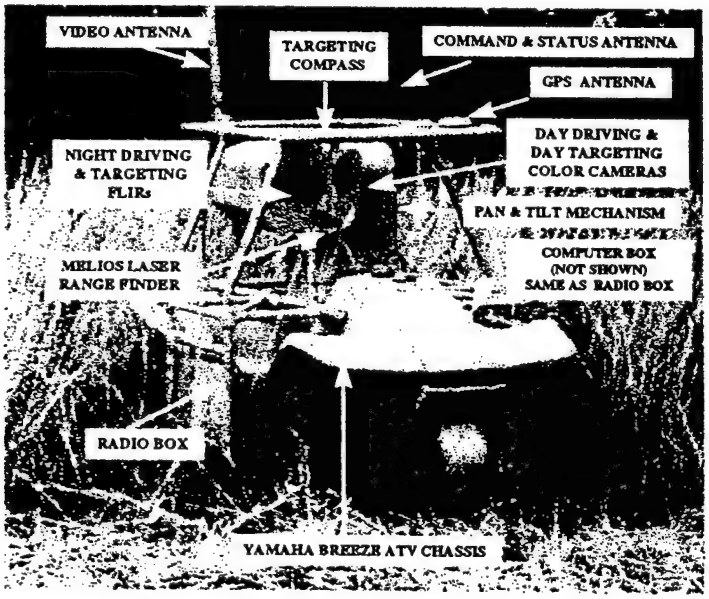

Figure 1. Remotely Controlled Multimission Platform (RCMMP)

B. OCR

The OCU is a small, suitcase-size, man-portable (not man-packable) control unit from which the operator remotely controls the RCMMP via a RF data link. The OCU is powered by the STH 24-V battery system, but can be powered by a generator. The OCU contains two displays: one provides the operator with real-time video from the driving and RSTA sensors located on the RCMMP, and the second portrays a 1:50,000 map of the area in which the RCMMP is operating. All functions necessary for controlling the RCMMP are found on the OCU. The operator manipulates the different menus on the OCU by a touch screen configuration.

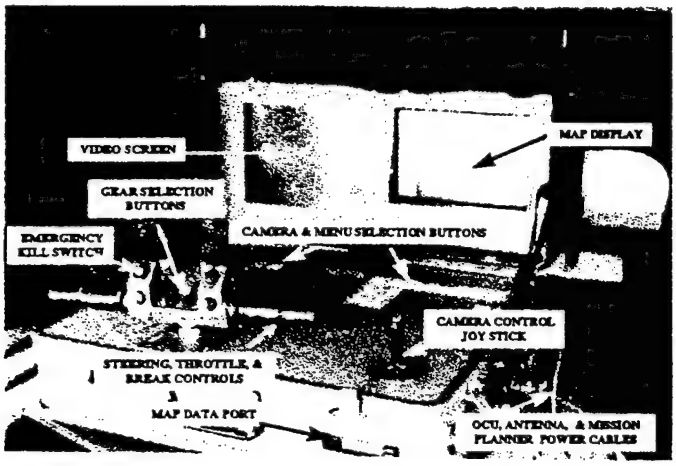

Figure 2. Operator Control Unit (OCU)

C. STH

The STH is a modified two-seater cargo version HMMWV used to transport the SARGE and the OCU/Mission Planner workstation. During transport, the OCU/Mission Planner table collapses to allow room in the rear of the STH for the SARGE RCMMP. The antenna box is also stored in the STH during SARGE transport. The generator, battery charger, and OCU power converter are stored in the two cargo holds in the rear of the STH. The SARGE vehicle is loaded and unloaded using folding ramps attached to the rear of the STH. The ramps can be raised and lowered by one soldier. Once the SARGE vehicle is off-loaded, the OCU/Mission Planner table is pulled out and pinned into place. The operator sits in a commercial "field chair" at the OCU/Mission Planner workstation in the back of the STH. From this OCU/Mission Planner workstation, the operator controls all functions of the RCMMP.

The RF/Video antenna mast is mounted on the right side of the STH (as viewed from the rear). The mast consists of four 5-foot manually telescoping sections, allowing it to extend to a maximum height of 25 feet when mounted on a HMMWV. The height of the antenna can be adjusted depending on the weather, terrain, and vegetation effects on the RF signal. An amplifier/filter box with antennas is pinned into place at the top of the telescoping antenna.

The STH is equipped with a Single Channel Ground-Air Radio System (SINCGARS) radio and an intercom system between the STH driver and the SARGE operator at the OCU in the rear of the STH.

The STH is equipped with a cab-mounted M60 machine gun for crew protection during SARGE transport and employment.

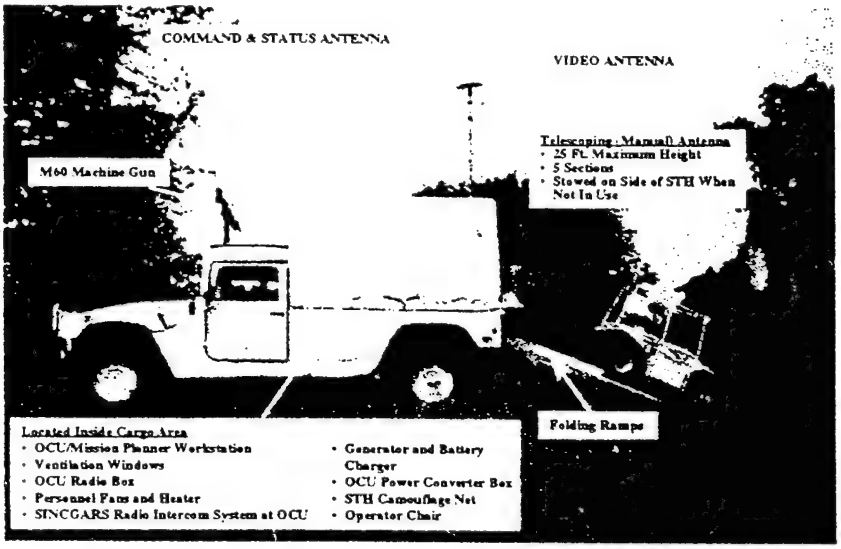

Figure 3. SARGE Transport HMMWV (STH)

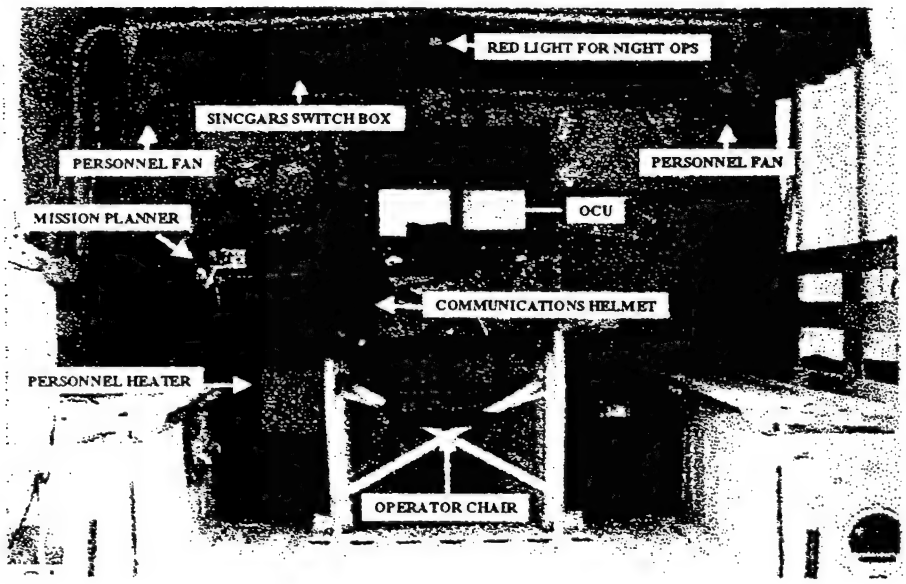

Figure 4. OCU/Mission Planning Work-Station (Rear of STH)

D. Mission Planner

A mission planner is provided with each SARGE system. The mission planner allows the SARGE operator to plan missions based on data link characteristics and to determine the best observation post location based on Line-of-Sight (LOS) analysis. It also allows the SARGE operator to draw and update both friendly and threat unit locations, and other operational graphics. The mission planner gives the operator the capability to "freeze" and send a frame of video, as well as standard reports, to other mission planner equipped elements via SINCGARS.

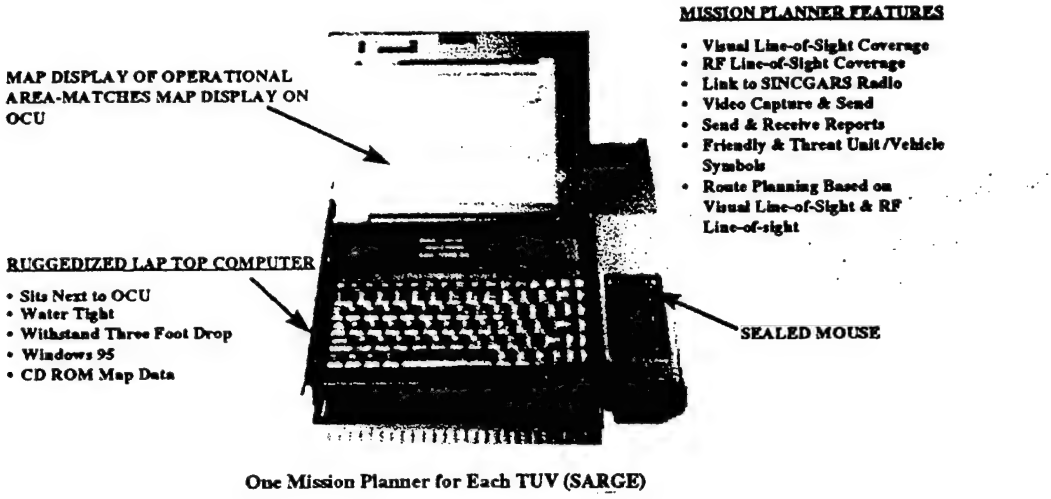

Figure 5. Mission Planner

E. SINCGARS and Intercom System

The SARGE operator communicates tactical intelligence information, collected by the SARGE, via the SINCGARS radio mounted in the STH. The STH operator and SARGE operator communicate via an intercom system between the HMMWV's crew compartment and OCU workstation located in the rear cargo area.

F. Pendant

The pendant is a small hand-held control device used by the operator to load and off-load the RCMMP, or to move it for short distances around a motor pool or tactical assembly area.

Figure 6. Pendant

G. Generator

Each SARGE system is equipped with a Honda X650 generator. This generator is the back-up power supply for the OCU and can be used to recharge the batteries on the RCMMP prior to and upon completion of its mission. If required, the generator can also be used to recharge the batteries on the STH.

Figure 7. Generator

H. Battery Charger

Each SARGE system has a battery charger capable of charging 6, 12, and 24-V batteries. The battery charger is used in conjunction with the generator to recharge the RCMMP batteries prior to and upon completion of the mission. The battery charger may also be used with the generator to recharge the STH batteries.

Figure 8. Battery Charger

I. OCU Power Converter

The OCU Power Converter is used to operate the OCU off the generator or AC power.

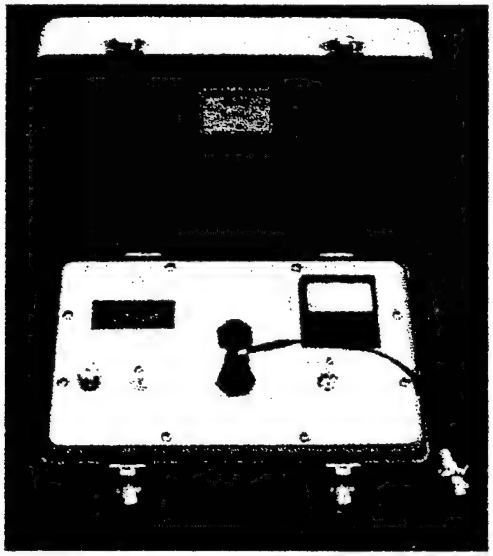

Figure 9. OCU Power Converter

VIII. SCOUT PLATOON ORGANIZATION

The 2-69 Armor Battalion scout platoon is a Bradley Fighting Vehicle (BFV) equipped scout platoon consisting of 6 BFVs and 30 personnel. With the integration of four SARGE systems, the scout platoon reorganized into a four Calvary Fighting Venicle (CFV) and four TUV (SARGE) platoon. The SARGE systems were manned with 3-man crews. In the fall of 1997, the scout platoon converted to a 10 HMMWV and 30 personnel configuration.

IX. TUV (SARGE) USER APPRAISAL TRAINING

A. JANUS Training

In September 1996, the JPO, in conjunction with the U. S. Army Infantry Center (USAIC) Directorate of Combat Developments (DCD), and the Dismounted Battlespace Battlelab (DBBL) developed a baseline set of TUV concepts of employment using map exercises and the JANUS simulations. Concepts of employment were developed for both offensive and defensive scout platoon missions, based on the SARGE systems limitations and capabilities.

In October 1996, the JPO conducted the initial TUV (SARGE) training for the 2-69 scout platoon leadership using the JANUS Simulation at the DBBL, Ft. Benning, Georgia.

The scout platoon leadership was given classes on the following subjects:

- JPO mission and objectives.
- TUV program overview.
- SARGE system description, capabilities and limitations.
- Baseline TUV SARGE TTPs previously developed.

The DBBL's standard force-on-force simulation (JANUS) was used to assist the scout platoon leader, platoon sergeant, and section leaders in developing initial SARGE concepts of employment. A computer model of the SARGE system was developed and, along with all of 2-69's other systems, incorporated into the JANUS database. Using National Training Center (NTC) terrain, threat forces normally encountered at NTC, and battalion operations orders from previous NTC rotations, the 2-69 scout platoon leadership developed platoon orders and executed their schemes of maneuver for both offensive and defensive scenarios in JANUS. This process allowed the scout platoon to experiment with alternative SARGE concepts of employment. Further, they were able to take the concepts of employment developed jointly between the JPO and the USAIC DCD, and modify them to better match their platoon and battalion standard operating procedures. As a result of the training, the scout platoon leadership was able to get an early understanding of the SARGE's capabilities and limitations, develop SARGE concepts of employment, and recommend modifications to the SARGE system well in advance of actually receiving the SARGE systems.

B. TUV (SARGE) Scout Platoon Leadership Operation and Maintenance Training

In November 1996, the JPO conducted a 5-day TUV (SARGE) training course for the scout platoon leadership at Redstone Arsenal, Alabama. The make-up of the scout platoon leadership included the platoon leader, platoon sergeant, four squad leaders, and one team leader. The 2-69 Armor Battalion S-2, and the 3d Brigade Assistant S-2 participated in the training. Observers included representatives from the U. S. Army Engineer School, U. S. Marine Corps Chemical and Biological Incident Response Force (CBIRF), and U. S. Army Test and Experimentation Command (TEXCOM).

The TUV (SARGE) training consisted of 60 hours of training in the following areas:

- TUV (SARGE) safety.
- TUV (SARGE) RF communication system.
- Operator Level Maintenance.
- TUV (SARGE) mission planning.
- OCU functions and operation.
- System setup and takedown.
- Preparing for teleoperation.
- Day and night teleoperation.
- Day and night teleoperation on the move (both the STH and SARGE RCMMP moving at the same time).
- Day and night land navigation.
- Day and night RSTA.
- TUV (SARGE) TTPs.

AARs were held daily at the conclusion of training. A final AAR was held on the last day to review the week's training activities. The AAR process was used to capture "lessons learned" on every aspect of the training using the TUV (SARGE).

C. Scout Platoon TUV (SARGE) Training

In January 1997, the JPO, in conjunction with the scout platoon, conducted a 4-day TUV (SARGE) training course for the entire 30-man scout platoon at Ft. Benning, Georgia. The TUV (SARGE) training course consisted of 60 hours of training in the following areas:

- TUV (SARGE) safety.
- TUV (SARGE) RF communication system.
- Operator Level Maintenance.

- TUV (SARGE) mission planning.
- OCU functions and operation.
- System setup and takedown.
- Preparing for teleoperation.
- Day and night teleoperation.
- Day and night teleoperation on the move.
- Day and night land navigation.
- Day and night RSTA.
- TUV (SARGE) TTPs.

D. Scout Platoon Lane Training

In March 1997, the scout platoon conducted section level lane training at Ft. Benning, Georgia. Each lane was defined by a specific piece of terrain with an associated mission of conducting an area or zone reconnaissance. The scout platoon organized each section with one CFV and one SARGE system for each lane. The scout platoon leader developed the scenarios and operation order for each mission. All the missions were conducted at night and lasted for approximately four to six hours. For each of the four nights, two scout sections conducted a mission on separate lanes. Due to resource constraints, the battalion leadership/staff decided that the opposing force/threat for this scout platoon training would consist of one HMMWV representing a threat reconnaissance section. This threat vehicle (HMMWV) was not equipped with a weapon system or a Multiple Integrated Laser Engagement System (MILES) kit. The battalion did not plan to use a robust threat force against the scout platoon until the battalion's final, force-on-force exercise just prior to its August 1997 rotation at the NTC at Ft. Irwin, CA. For reasons explained later in this report, the SARGE systems did not participate with the scout platoon in this final field exercise. A JPO representative from the User Appraisal Team Forward accompanied each section during the execution of its mission on a non-interference basis. The representative used a voice activated recorder to capture events as they occurred, but did not assist or ask questions of the TUV (SARGE) section. An AAR was conducted at the completion of each night's training. A comprehensive AAR was conducted upon completion all training. The training objectives were to:

(1) Tactically employ the TUV (SARGE) with scout platoon CFV,

(2) Further develop TUV (SARGE) TTPs for selected scout platoon missions:

- Route Reconnaissance.
- Zone Reconnaissance.
- Area Reconnaissance.
- Screen.

(3) Develop an initial set of TUV specific Leader, Individual, and Collective Tasks.

(4) Appraise the TUV (SARGE) performance in a woodland environment.

(5) Appraise the TUV (SARGE) RF range in a woodland environment.

E. TUV (SARGE) Desert Training

In April 1997, the User Appraisal Team Forward, the scout platoon leadership, and the Battalion S-2 deployed to the MCAGCC, 29 Palms, California to conduct desert training with the SARGE system. For five days, the scout platoon conducted scout missions with four SARGE systems. On each day, a day and night mission was conducted. Each mission lasted approximately six to eight hours. No opposing force/threat was used for this training. Instead, the platoon leader tasked each of the SARGE teams to report any USMC vehicles or personnel observed in their respective areas. This worked well since the level of USMC training activity at 29 Palms was particulary heavy and provided many opportunities for the SARGE teams to observe, detect, identify, report, and target vehicles and personnel. For selected missions, representatives from the User Appraisal Team Forward accompanied two of the SARGE teams during the execution of their mission on a noninterference basis. The representative observed events as they occurred and did not assist or ask questions of the TUV (SARGE) section. The observations were captured during the end-of-training day AARS. The scout platoon Leader, in conjunction with the Battalion S-2, developed the scenarios and operations orders for each day's missions. A comprehensive AAR was conducted upon completion of the five days of training. The training objectives were to:

(1) Further develop TUV (SARGE) TTPs for selected scout platoon missions:

- Route Reconnaissance.
- Zone Reconnaissance.
- Area Reconnaissance.
- Screen.

(2) Further develop TUV specific Leader, Individual, and Collective Tasks.

(3) Appraise the TUV (SARGE) performance in a desert environment.

(4) Appraise the TUV (SARGE) RF range in a desert environment.

X. MAINTENANCE AND LOGISTICS SUPPORT

A. Maintenance

The maintenance plan for the SARGE and the STH was divided into SARGE operator level maintenance, SARGE organizational level maintenance, Direct Support (DS) maintenance, and depot level maintenance. One SARGE system (fifth System) was reserved as a maintenance float.

1. Operator Level Maintenance. A Preventative Maintenance, Checks, and Services (PMCS) Guide was developed by the JPO for SARGE system operator level maintenance. The SARGE PMCS Guide covers all operator level "before," "during," and "after" operations maintenance checks. The standard HMMWV operators' manual was used for operator level maintenance on the STH. The scout platoon soldiers used these two manuals to perform operator level maintenance on the SARGE system and STH.

2. Organizational Level Maintenance

a. SARGE Transport HNMWV

Per the MOA, the 2-69 Armor Battalion agreed to perform organizational level maintenance on the five STHs and their SINCGARS radios. The JPO incurred the cost for this maintenance. An account was established that allowed the battalion to replace parts used from their organic stock of HMMWV and SINCGARS radio parts. All fuel and lubricants used by the battalion for the operation of the STHs were also reimbursed via this account. Prior to any SARGE system (including the STH) departing the 2-69 motor pool, an inspection of the entire system was conducted in-turn by the SARGE system operator, a battalion HMMWV mechanic, and the battalion's quality control section. Once all identified maintenance deficiencies were corrected, the SARGE system was approved for operation outside the motor pool by the Battalion Maintenance Officer (BMO). This dispatch procedure for vehicles departing a motor pool for field exercises or convoys is standard operating procedure for all Army units.

During field training exercises, the 2-69 Armor Battalion provided an STH organizational level maintenance contact team. No STH required organizational level maintenance at any point during field training exercises.

b. SARGE System (Less the STH)

The SARGE integration and support contractor (to the JPO) provided two on-site SARGE maintenance technicians to perform all SARGE system (less the STH) maintenance above operator level. The SARGE integration and support contractor maintained one on-call SARGE maintenance technician at its home facility, as well as on-site SARGE engineer. The function of the on-site engineer was to advise the maintenance technicians on corrective maintenance actions and priorities of maintenance efforts before, during, and after training events. Each of the maintenance technicians was provided

maintenance HMMWV by the JPO for transporting tools, spare parts, and diagnostic equipment. During training exercises, each maintenance technician was assigned the maintenance responsibility for two SARGE systems. Each maintenance HMMWV was equipped with a SINCGARS radio to allow the maintenance technicians to communicate with the scout platoon SARGE sections. The maintenance technicians were deployed in a position 2 to 4 km to the rear and center of the SARGE systems. The SARGE on-site engineer accompanied one of the maintenance technicians, and maintained communication with the other technician via SINCGARS. If a SARGE system required maintenance during field training, the maintenance technician and engineer would troubleshoot the problem with the operators via SINCGARS. If the operator could not correct the maintenance problem, the maintenance technician would move forward and correct the problem. If two SARGEs belonging to one maintenance technician experienced problems at the same time, the maintenance technician would attempt to fix the system exhibiting less complex problems first, then move to the second system. For each maintenance action, maintenance forms were filled out containing the action performed, parts used, and time to complete the action. These forms were provided to the JPO as part of the User Appraisal feedback.

3. DS Maintenance and Depot Level Maintenance

a. SARGE Transport HMMWV

In agreement between the 2-69 Armor Battalion and its DS maintenance unit, the 203d DS Maintenance Battalion, would complete all STH maintenance above organizational level. An account was established by the JPO to reimburse the 203d Maintenance Battalion for parts used to repair the STHs.

In the event the 203d DS Battalion was unable to perform maintenance due to a backlog of work, a like agreement was established with the Directorate of Logistics (DOL) at Ft. Benning, Georgia to perform direct support level maintenance on the STHs. An account was established that allowed the DOL to order parts at the expense of the JPO to replace parts used from the DOL's organic stock of HMMWV and SINCGARS radio parts. The Ft. Benning DOL was never used for STH maintenance.

b. SARGE System (Less the STH)

The USAAMCOM MRDEC RIL served as the SARGE depot level maintenance facility. RIL engineers at Redstone Arsenal, Alabama provided troubleshooting support via telephone with the SARGE maintenance technicians and engineer. If maintenance failures could not be corrected using this process, the system would be evacuated back to the RIL for repair. Troubleshooting via telephone proved to be effective, and no SARGE systems were evacuated back for depot level maintenance.

B. Logistics

The logistics plan incorporated SARGE system (less the STH) spare parts; tools, special tools, and diagnostic equipment; maintenance facilities; and administrative support equipment.

1. Spare Parts. The JPO, in conjunction with the SARGE integration/support contractor and USAAMCOM MRDEC RIL, developed a list of spare parts required for the duration of the User Appraisal. The baseline for the list was the amount of spare parts used during the burn-in testing of the five SARGE systems at Redstone Arsenal prior to hand-off to the 2-69 Armor Battalion. When a failed but repairable spare part was removed from a system, it was returned to the integration/support contractor's facility for repair. The contractor, in turn, shipped a functional spare part to the on-site maintenance technicians to maintain stockage.

2. Tools, Special Tools, and Diagnostic Equipment. A set of tools, special tools, and diagnostic equipment was developed for each of the on-site SARGE maintenance technicians and engineer.

3. Maintenance Facilities. The JPO' User Appraisal Logistics Specialist coordinated all requirements for maintenance support at Ft. Benning, Georgia and other User Appraisal locations. Per the MOA, a 12 x 24-foot temporary building was placed in the 2-69 Armor Battalion's motor pool. The Ft. Benning Directorate of Housing and Engineering connected power to the building. This building was used to store spare parts, tools, special tools, and diagnostic equipment. Additionally, two SARGE systems could be moved into the building for maintenance. The majority of maintenance was conducted in this building or directly outside. Per agreement with the 2-69 Armor Battalion Maintenance Officer, space was made available in the Battalion's maintenance bays on an as-needed basis. The four SARGE systems and two maintenance support HMMWVs were stored in the 2-69 Armor Battalion motor pool per the MOA.

The JPO's User Appraisal Logistics Specialists coordinated all system shipping, maintenance, logistics, administration, rations, training areas, and billeting for the User Appraisal desert training at MCAGCC, 29 Palms, California. The JPO reimbursed the USMC for all fuel and HMMWV and SINCGARS spare parts used to support the training.

4. Administrative Support. Per the MOA, the 2-69 Armor Battalion provided the User Appraisal Team with an office inside the battalion's motor pool building. The battalion renovated this office to include painting, installing new lighting, installing a wall heater, and installing commercial and DSN phone and fax lines. The JPO reimbursed the battalion for the renovation. The JPO purchased phones and a copier/fax machine for the office. The JPO stocked the office with the necessary office supplies. Additionally, the JPO contracted for cell phones and pagers for the primary members of the User Appraisal Team Forward. This proved instrumental for communications efficiency. This was especially true when the scout platoon was in the field training with the SARGE systems and communications were required with members of the User

Appraisal Team Forward in the main post area of Ft. Benning, and the JPO and USAAMCOM MRDEC RIL at Redstone Arsenal, Alabama.

5. Temporary Duty (TDY). TDY in support of User Appraisal activities was extremely heavy. Between October 1996 and June 1997, the members of the User Appraisal Team Forward spent an average of 10 days per month TDY in support of the User Appraisal.

XI. FREQUENCY MANAGEMENT

A. Discussion

Each SARGE system requires three frequencies for operation: A video frequency, a command frequency, and a status frequency. For each User Appraisal location (Redstone Arsenal, Ft. Benning, and 29 Palms), the JPO coordinated with the local frequency manager for frequency allocation for each of the four SARGE systems. This particular area of coordination was the most time consuming of all User Appraisal coordination requirements. On one occasion, it took almost four months to complete the frequency allocaton process. The SARGE system frequencies, by system, are listed below:

SARGE 4	Video:1815MHz/Command:407.250 MHz/Status:413.400 MHz
SARGE 5	Video:1792MHz/Command:407.300 MHz/Status:413.225 MHz
SARGE 6	Video:1763MHz/Command:407.475 MHz/Status:413.500 MHz
SARGE 7	Video:1733MHz/Command:406.175 MHz/Status:412.850 MHz.

Generally, the four SARGE systems had to be operated in the field several hundred meters apart from one another to prevent mutual interference caused by the closeness of the frequencies assigned. This was not a problem except when the scout platoon, in a tactical assembly area, attempted to bring up two or more systems at the same time. Because of this, the Scout operators could only bring one system up at a time to conduct pre-operation maintenance checks per the platoon Standard Operating Procedure (SOP).

The lack of RF separation also presented a problem to the JPO during system testing at its Redstone Arsenal practice facility. The JPO's goal was to test three to four systems simultaneously. The best that could be achieved by retuning radios to maximize frequency separation was the testing of two systems simultaneously.

B. Recommendation

Although the Scouts learned to work around this inconvenience, the fielded TUV should have frequency separation great enough to allow all TUVs to be turned on at the same time without interference among the TUVs or other tactical radios while in an assembly area posture. The ability for the operator to select system frequencies at the OCU via software would be an excellent feature for the fielded TUV.

XII. USER APPRAISAL CONTRACTING

The JPO contracted for the initial fabrication, integration, and maintenance support of seven SARGE systems. The contract was a Cost Plus Fixed Fee - completion contract. Additionally, per the MOA, the JPO committed to making SARGE system reliability, maintainability, and performance improvements based on feedback from the scout platoon. For contracting purposes, this proved to be very cumbersome. The level of effort was unknown until user feedback was collected, but changes were required to be contractually covered under a completion type contract. Any recommended changes by the scout platoon required a "new effort" to be incorporated into an updated statement of work and negotiated with the SARGE integration/support contractor.

With the intentions of making SARGE system reliability, maintainability, and operational performance improvements during non-training periods and in time for the next scout platoon training exercise, the requirement to re-negotiate the basic contract for every set of SARGE system improvements proved to be impractical and consumed precious time. It resulted, in many cases, in having to stretch out SARGE system improvement efforts longer than was desirable for both the JPO and the scout platoon. A more flexible contracting arrangement would have been desirable, allowing the contractor to more quickly execute the changes to the SARGE system as requested by the scout platoon.

Two possible contracting alternatives were available, but neither provided the flexibility that was desired. One was to establish a separate Contract Line Item Number (CLIN) for labor hours only to support changes as a result of scout platoon feedback. This method required the integration/support contractor to provide hours in the performance of the effort, but required no deliverable end product. The second contracting alternative was to establish a separate CLIN to cover User Appraisal support. It would be established as "1 Lot" of effort at a specified dollar amount and no fee since the risks are indeterminable. The Project Officer would direct changes in the effort until the CLIN funds were expended. The integration/support contractor would probably not agree to providing this effort with a "no fee" provision and the Federal Acquisition Regulation or Defense Federal Acquisition Regulation does not presently allow for a type of contract that permits such flexibility.

XIII. TACTICS, TECHNIQUES, AND PROCEDURES (TTP)

Based on the three primary scout platoon Collective Tasks that support the battalion's Mission Essential Task List (METL), and their use of the SARGE system, the 2-69 Armor Battalion scout platoon developed the following set of TTPs for inclusion in this report.

A. Mission Essential Task 1. Prepare for Combat/Conduct Sustainment Operations

As both of these collective tasks do not necessarily involve maneuver of the platoon, the primary use for the SARGE in these areas was in tactical assembly area operations. In establishing a tactical assembly area, one or more SARGE systems were used in conjunction with the quartering party. The SARGE provided forward security for the quartering party moving forward of the main body to secure the assembly area. In non-specific terms, not taking into account the factors of Mission Equipment, Time, Terrain and Troops (METT-T), the SARGE was generally pushed forward about a terrain-feature away to provide eyes forward of the quartering party. The SARGE was used to clear the proposed assembly area; to determine the presence of threat forces; determine the trafficability of the terrain; and to determine the suitability of the ground surface. Once all this information was gathered and disseminated, the rest of the quartering party was free to move in to conduct standard assembly area quartering party tasks. The SARGE systems were then used to provide security for the quartering party as they established the assembly area.

Once the remainder of the scout platoon moved into the assembly area, the SARGE systems were used for local security. This provided the assembly area with maximum security at a range much greater than would be possible with only the BFV (M3A2) sights. Each SARGE system was used to cover an avenue of approach leading into the assembly area.

The other collective and leader tasks exercised within Prepare for Combat/Conduct Sustainment Operations that involved the SARGE systems were:

- Perform Pre-Combat Checks.
- Perform Rehearsals.
- Prepare for Tactical Operations.
- Employ Operations Security.
- Perform Maintenance Operations.

B. Mission Essential Task 2. Perform Reconnaissance Mission

The SARGE was used extensively during all types of reconnaissance missions. However, in order to conduct forward reconnaissance, the SARGE system was required to conduct tactical movement. When moving in conjunction with the rest of the platoon, the SARGE was used in several ways: (1) The platoon deployed and teleoperated the SARGE on the move. In these cases, movement was slow and deliberate, with the SARGE system pushed

forward to clear around bends and over ridgelines; (2) The SARGE system was used in a bounding overmatch technique, making the first bound in front of the scout section, to clear forward before the manned assets moved; (3) Conversely, if time was of the essence and security not so important, based on the Intelligence Preparation of the Battlefield (IPB) and METT-T, the SARGE systems moved with the rest of the platoon in a stored configuration. In this case, the platoon moved in one of the seven tactical formations; and (4) Occasionally, the SARGE system conducted movement separate from the remainder of the platoon. In these cases, the SARGE system cleared areas forward of the STH, using the best-covered and concealed routes in order to avoid detection by threat forces. Once the SARGE systems completed tactical movement to their assigned reconnaissance area, they conducted one of three types of reconnaissance missions:

1. Route Reconnaissance. The SARGE was used as forward security for the platoon's mounted and dismounted forces conducting the route reconnaissance. SARGE systems cleared around corners or over the next terrain feature to provide the security necessary for the platoon to measure curves, road widths, and identify other obstacles in order for the battalion to maneuver along the route. In addition, the SARGE was used to clear lateral routes, providing lateral security for mounted and dismounted forces conducting the route reconnaissance tasks.

2. Zone Reconnaissance. The SARGE generally conducted tactical movement in conjunction with the other platoon assets to determine the presence of any threat forces within the zone. Once the zone was cleared, the SARGE systems were set in observation posts to overmatch a particular named area of interest, to provide early warning, and to direct fire on threat forces.

3. Area Reconnaissance. Similar to the zone reconnaissance, the SARGE system was used in conjunction with other platoon assets to determine the presence of threat forces within sector. While dismounts used a prescribed technique to clear the area, the SARGE systems were used to provide far side or flank security around the area in question. Once the area was clear, the SARGE systems were set in observation posts to overmatch specific named areas of interests.

4. Other collective tasks exercised in Perform Reconnaissance Missions that involved the SARGE system were:

- Conduct Tactical Movement.
- Employ Command and Control Measures.
- Reconnoiter an Obstacle and a Bypass.
- Execute Actions on Contact.

5. Conduct a Screen. When the scout platoon was given the mission to conduct a stationary screen, the SARGE proved to be extremely useful. Once set into an observation post, each SARGE system was used to keep eyes on a specific named area of interest to provide early warning to the battalion of threat forces. Particularly useful was the SARGE system's ability to

cover high-speed avenues of approach. The SARGE system was pushed forward of the main screen line (manned screen line), especially in desert terrain, providing very early warning of advancing threat forces. This early warning helped to alert the battalion of the enemy axis of advance and the composition of the threat force.

Other collective and individual tasks exercised in conducting a screen that involved the SARGE were:

- Produce a range card/Fire Plan.
- Employ Operation Security.
- Execute actions on contact.

C. Mission Essential Task 3. Perform Passage of Lines

The SARGE system played a key role in Passage of Lines Operations. SARGE systems were employed to provide additional security for manned assets at passage points and were also placed along the Battle Hand Off Line (BHL) where they had the best possible observation of enemy avenues of approach. Additionally, SARGE systems were used to watch passage lanes leading from the passage points to the release points, and to provide additional security for assembly areas to which the passing units moved to after departing the release points.

D. Scout Platoon's Summary on the SARGE System

The scout platoon felt strongly about the SARGE system's utility, and provided the following comments:

The integration of a TUV into a mechanized scout platoon requires some time to properly train the soldiers on the system's operation and tactical employment. However, the SARGE system proved to be a very useful unmanned reconnaissance and surveillance tool for the scout platoon.

"It is clear from our (scout platoon) use of the SARGE for a 6-month period in various terrain and environmental conditions that the TUV (SARGE) system can play an important role in the mechanized maneuver battalion's reconnaissance and surveillance plan."

XIV. KEY LESSONS LEARNED

The lessons learned from the TUV User Appraisal Phase I are separated into system specific areas. This section is not intended to be an indictment of the SARGE system. It was known at the beginning of the User Appraisal that the SARGE system had certain system reliability, maintainability, and performance limitations, as well as certain capabilities. It is the lessons learned from these limitations and capabilities that will assist the TUV Combat and Materiel Developers in developing and fielding the first TUV that meets the TUV operational performance requirements of Army and Marine Corps units.

A. TUV Operational Effectiveness

1. Discussion. A detailed analysis of the TUV's operational effectiveness based on data collected using instrumentation and human data collectors was not a stated goal of the TUV User Appraisal Phase I. The goal of the User Appraisal was to gain subjective insights into the "potential" operational effectiveness of the TUV based on the subjective feedback of the User Appraisal unit.

During the platoon level training (scout platoon) described in this report, the SARGE systems were not outfitted with MILES or other instrumentation to collect "hard" data on Measures of Effectiveness (MOE) and Measures of Performance (MOP) to assess the system's Critical Operational Issues (COI). Also, human data collectors were not used to gather detailed information pertaining to the TUV's operational effectiveness based on the SARGE system. This was in keeping with the User Appraisal's designed "non-intrusive" approach on unit training.

The 2-69 Armor Battalion, and its parent brigade, agreed to take the SARGE systems, integrated into the scout platoon, to the battalion's NTC rotation. The 2-69 Armor Battalion's final force-on-force (battalion level) field exercise before its NTC rotation, and the actual NTC rotation, would have provided the best opportunity for collecting insights into the TUV's operational effectiveness based on the SARGE prototype. However, the coordination necessary to allow the SARGE system's participation with a rotational unit (2-69 Armor) in a NTC rotation encountered several problems. The UGV/S JPO elected to conclude the User Appraisal with the 2-69 Armor Battalion after the scout platoon's training at 29 Palms, CA. The SARGE systems did not participate in the force-on-force (battalion level) field exercise prior to the NTC rotation.

The UGV/S JPO was able to garner the collective opinion of the scout platoon concerning the potential operational effectiveness of a TUV equipped battalion/scout platoon based on their platoon level training. In an interview with the Army Science Board (ASB), the scout platoon told the ASB team that they endorsed the TUV concept and that the TUV will increase the scout platoon's survivability, increase the number of observation posts it can occupy, provide "freeze frame" video of threat forces/targets for analysis by the battalion's intelligence officer, expand the distance the platoon can conduct reconnaissance from its battalion without concern for indirect fire support, and increase the operational effectiveness of the battalion as a

whole. Additionally, the scout platoon stated that the Army and Marine Corps should continue efforts to develop and field the TUV.

2. Recommendation

a. If future User Appraisals are designed to assess in detail the operational effectiveness of a TUV equipped battlion/scout platoon, the TUV prototypes should at least participate in a battalion level, MILES-equipped, force-on-force field exercise against a robust threat force. The coordination necessary for this field exercise needs to begin well in advance, and should start with the User Appraisal unit's division headquarters. The TUV Combat Developer should be an integral part of this coordination.

b. If future User Appraisals include a rotation at one of the Army's training centers, the coordination for this effort must start at least one year in advance, beginning with the NTC or Joint Readiness Training Center (JRTC) Desk Officers at the U. S. Army Forces Command (FORSCOM), Fort McPherson, GA. Extensive coordination is required in order for a prototype system to participate in a training center rotation, especially if the system is not part of the unit's standard table of equipment or the TF XXI Advanced Warfighting Experiment (TF XXI AWE). A one-year advance start is a reasonable amount of time to effect the required coordination. The TUV Combat Developer should be an integral part of this coordination.

B. TUV RF Communications Link

1. Discussion. The RF communications link used on the SARGE system to provide the operator with "real-time" video feedback for teleoperation and RSTA allowed the RCMMP to be deployed out to approximately 1,200 meters (best case) in the heavily vegetated terrain at Ft Benning, GA., and out to approximately 3,900 meters (best case) in the more open desert terrain at 29 Palms, CA. In order to achieve "RF" RCMMP deployment distances (the distance between the RCMMP and the OCU) of 4 km and greater as required in the TUV ORD, especially in heavily vegetated terrain, it may be necessary for the fielded TUV to have an OCU antenna with a maximum height much greater than the 25 feet found on the SARGE prototype TUV.

2. Recommendation. It is recommended that the UGV/S JPO investigate tactically feasible technologies that may be available for raising the OCU's antenna array well above the 25 foot height used during the User Appraisal. A tactical balloon or pneumatic telescoping antenna mast are two possibilities for increasing the height of the OCU antenna array.

C. Operator Control Unit (OCU)

The User Appraisal OCU consisted of the following components:

- The OCU itself with all the controls for teleoperation and operation of the RCMMP (OCU mounted on a collapsible table in the STH).

- The power source (HMMWV batteries).

- Radios for communication with the RCMMP (mounted in the STH to the right of the OCU).

- A 25 foot telescoping antenna (mounted to the side of the STH).

- The Mission Planner (mounted to the left side of the OCU) for planning missions and sending freeze frame video images and reports to the Scout Platoon Leader and the Battalion S-2.

- The tactical radio for communication with other scout platoon elements and the Scout Platoon Leader (SINCGARS Radio mounted in the cab of the STH).

1. OCU Operation In Bright/Sunny Conditions

a. Discussion. The LCD screens on the OCU used for the User Appraisal washed out in bright sunlight making it very difficult to see driving video and map displays. To overcome this limitation, the OCU was operated from within the STH, which provided a cover to block out sunlight. Except for one excursion, the OCU was never operated in a ground-emplaced mode. The black cloth hood provided with the User Appraisal OCU blocked sunlight, but was undesirable because it degraded soldiers' ability to hear, tended to be claustrophobic for some operators, and caused the soldiers to overheat during hot conditions. The overheating problem was magnified when the soldiers were in MOPP IV.

b. Recommendation. The fielded TUV OCU will have to account for bright conditions if it intended for the OCU to be operated outside of a vehicle.

2. OCU Mobility

a. Discussion. OCU Mobility was determined to be a requirement during User Appraisal, for several reasons:

(1) First, the RF range (OCU to RCMMP) of the system was limited. In the heavily vegetated terrain at Ft. Benning, Georgia, the SARGE averaged a RF range of approximately 800 to 1000 meters, with 1200 meters being the best distance achieved. In the more open desert terrain at 29 Palms, California, the system averaged a RF range of approximately 2000 to 2500 meters with 3800 meters being the best distance achieved. Due to the RF range limitation, the OCU had to constantly move to maintain (or regain) a good RF link with the RCMMP. By placing the OCU in the STH, the operators could quickly move the OCU to maintain a good RF link and overcome the RF range limitation.

(2) Second, the operational tempo of the 2-69 Armor scout platoon required that the SARGE be able to keep up with the BFVs employed by the remainder of the platoon. Again, by placing the OCU in the STH, the operators were able to keep the RCMMP and the OCU moving forward at a pace fast enough to keep up with the BFVS. The preferred method of employment was to move both the STH and the RCMMP at the same time. This

employment technique was known as "teleoperation on the move." The scout platoon did at times teleoperate the RCMMP while the STH was stationary, and then move the STH forward when the RCMMP reached the limit of the RF link.

(3) Third, the OCU emits a constant RF signature. In the opinion of the 2-69 Armor scout platoon, the OCU would be unable to stay in one position for any great period of time without the risk of being located and targeted by threat RF direction finding systems. As with artillery units that move after firing a certain number of missions, the constant RF stream emitted from the OCU requires it to be very mobile unless a nonemitting communication link, such as fiber optic cable, is used as the primary communication link.

It is not feasible to operate the OCU in a ground-emplaced mode. The weight of the OCU and its associated components, approximately 80 pounds, made it impractical to manpack (equipment in a rucksack), or manport (two or more soldiers lugging the equipment). Additionally, the time required to setup and takedown the OCU and its associated equipment, even if it could have been manpacked or manported, would have been much too slow to keep pace with the remainder of the scout platoon. In its original design configuration, the SARGE system took 90 minutes to setup in a ground mode and approximately the same time to take down and store for movement. This was one reason for the addition of the STH. Once the OCU and its associated equipment were placed in and attached to the STH, it took only 10 minutes for 2 soldiers to setup or takedown the system.

b. Recommendation. It is recommended that the OCU be mounted in a mobile platform.

3. Environmental Survivability

a. Discussion. The OCU was neither waterproof nor capable of operation in extreme cold or heat. The STH was designed to house the OCU for protection from rain, snow, ice, cold, direct heat, and to some extent dirt, sand, and dust. The rear of the STH was outfitted with a small heater, connected to the HMMWV engine, to heat the back of the STH and keep the OCU warm in extreme cold conditions. The cargo cover on the STH provided protection from precipitation, blowing sand, ice, and dirt the OCU would encounter in a ground emplaced mode. The roof of the cargo area of the STH was lined with marine grade plywood and the seams treated with waterproofing to keep the cargo cover from leaking.

b. Recommendation. The fielded TUV OCU will have to be waterproof and capable of operation in hot and basic climate conditions (120 to –25 °F). This is especially true if the OCU is intended to be operated outside of a vehicle in a ground-mounted mode of operation.

4. OCU Map Database

a. Discussion. The User Appraisal OCU's map database proved to be too small and the process to load maps too time-consuming. In order to load a map of an operational area into the OCU, a 1:50,000 paper map had to be scanned, cleaned up after the scanning process, loaded onto PCMCIA cards, and then loaded onto the OCU via a port on the front of the OCU.

This process was very time-consuming. For example, it took several weeks to prepare the Ft. Benning, Georgia, map for loading into the OCU. In comparison to actual potential operational areas a TUV might encounter in wartime operations, the Ft. Benning area is very small. A mechanized Infantry scout platoon could conceivably cover an area two to three times the area of Ft. Benning, Georgia in a matter of a few days.

b. Recommendation. The fielded TUV OCU must be capable of quickly accepting digitized map information of an area at least 50 by 50 km, loaded by the operator. An Infantry scout platoon, during wartime operations, could encounter a very large operational area or see its operational area shift to a completely different geographical area in a matter of days. A large capacity, easy to use, digitized OCU map database is imperative for the fielded TUV.

5. OCU LCD-Screen Light Signature

a. Discussion. The User Appraisal OCU LCD-screens emitted too much light to be used during night operations without a cover to block the light and prevent the OCU's position from being detected by threat forces. The black cloth hood provided with the OCU blocked the light, but presented the same problems as already discussed. By placing the OCU in the STH, the cargo cover blocked the light emitted from the LCD screens. The portion of the cargo cover that separates the STH crew compartment from the cargo area was modified with a blackout cover over the existing plastic window. This was requested by the 2-69 scout platoon because light from the LCD screens was escaping through the plastic window and through the crew compartment.

b. Recommendation. The fielded TUV OCU will have to be designed to prevent light from compromising the OCU's position.

6. Mission Planner

a. Discussion. The Mission Planner proved a very effective tool for the TUV operators. This stand-alone tool allowed the operators to: (1) Plan routes for the RCMMP based on the system's RF communication link and mobility parameters; (2) Select positions for the STH/OCU based on the system's RF communication link parameters; (3) Determine the best observation post positions for the RCMMP based on the system's sensors using LOS analysis; and (4) Draw friendly and threat operational graphics and symbols. The mission planner also allowed the operators to capture "freeze frame" video from the OCU and transmit these images via SINCGARS to other scout platoon elements.

Operators at Ft. Benning and 29 Palms were able to maximize the system's RF range by predetermining routes and positions for the RCMMP and STH/OCU when developing their reconnaissance and surveillance plans (based on the system's RF, mobility, and sensor capabilities).

b. Recommendation. It is recommended that the goal for the fielded TUV mission planner be to integrate its capabilities into the OCU. This not only deletes an additional piece of hardware, but allows the TUV operator to plan, display, and update information on the OCU map screen, and transmit "freeze frame" video to other tactical elements.

D. Remotely Controlled Multi-Mission Mobile Platform (RCMU)

1. RCMMP Traction and Power

a. Discussion. The SARGE RCMMP is based on the Yamaha Breeze All-Terrain Vehicle (ATV). The Yamaha Breeze is a small, 2-wheel (rear) drive ATV powered by a 4 stroke, 125cc gasoline engine. Off the showroom floor, the Yamaha Breeze weighs 317 pounds and is rated to carry a payload of 225 for a total weight of 542 pounds. The SARGE RCMMP weighs 560 pounds, 18 pounds more than Yamaha's recommended total payload.

The RCMMP's 2-wheel drive system and relatively small engine proved to be inadequate both at Ft. Benning, Georgia and 29 Palms, California. In several instances, the SARGE RCMMP bogged down in mud-holes at Ft. Benning, and slipped in the steep, sandy, and rocky terrain at 29 Palms. The front and rear sprockets on the SARGE RCMMP were replaced with larger sprockets to improve the platform's engine torque. The change in sprockets did improve the pulling power of the RCMMP, but this improvement was negated by the lack of 4-wheel drive when the RCMMP encountered muddy or sandy/rocky terrain. With the planned modifications to the system to integrate a fiber optic cable system, military GPS, frequency agility hardware, and additional batteries, the weight will increase to 652 pounds or 110 pounds over Yamaha's recommended maximum payload capacity. Heavy-duty front and rear shocks have been added to the SARGE systems to help compensate for the added weight.

b. Recommendation. Although mobility field tests have shown the Yamaha Breeze will pull 652 pounds, a larger platform with 4-wheel drive and a larger engine will be necessary for the objective TUV to adequately carry its mission payloads and negotiate expected terrain conditions.

2. RCMMP Wheelbase and Ground Clearance

a. Discussion

The SARGE RCMMP's wheelbase of 42.5 inches was inadequate to keep the RCMMP from rolling onto its side when attempting to negotiate uneven terrain. In several instances, 4-wheel drive would have helped the remote platform to pull itself out of these situations instead of spinning and eventually rolling over.

The SARGE RCMMP's 6-inch ground clearance proved inadequate, especially during operations in the heavily wooded terrain at Ft. Benning. On numerous occasions, the RCMMP got hung-up on small logs and fallen limbs. Again, a 4-wheel drive system would have helped in these situations, but just as important for TUV cross-country

mobility is a high ground clearance. The SARGE RCMMP did not experience any ground clearance limitations in the desert terrain at 29 Palms.

Another consideration for high ground clearance is the fording of streams, creeks, and standing water. The 6-inch ground clearance prevented the SARGE RCMMP from crossing the majority of the streams and creeks found at Ft. Benning. This required the operators to carefully plan the RCMMP routes and, on several missions, required a more circuitous, time-consuming RCMMP route.

b. Recommendation. A larger remote platform with a wider wheelbase is desirable for the TUV to provide added stability when negotiating uneven terrain. A remote platform with a high ground clearance is necessary for the objective TUV to negotiate terrain during cross-country operation.

3. RCMMP Mast

a. Discussion. The SARGE RCMMP is not equipped with a mast of any type to elevate the sensors. The 2-69 scouts felt that a mast would give the SARGE RCMMP an added capability to look over vegetation, walls, rock outcrops, and in certain cases, enable the RCMMP to be emplaced on the reverse slope of a hill with the mast elevated. This would improve survivability by allowing the RCMMP to hide in vegetation, behind walls, and the reverse slope of hills.

b. Recommendation. The 2-69 scouts recommended that the fielded TUV RCMMP have a mast that will elevate the sensors to a height of 4 to 6 feet.

E. Driving and Targeting Sensors

1. Day and Night Remote Driving Sensors

a. Discussion. The SARGE RCMMP is equipped with a 50-degree Field-of-View (FOV) color camera for daytime remote driving and a 40-degree FOV FLIR for remote driving at night. The 2-69 scout platoon operators, as a whole, felt that 50 degrees and 40 degrees, respectively, were not adequate FOVs for remote driving sensors. In the opinion of the scout operators, these FOVs gave them a sense of "tunnel vision" and did not allow them to see enough of their periphery while remotely driving the RCMMP. As Army scouts, they are accustomed to being able to look 360 degrees while conducting reconnaissance from a vehicle or while on foot. On one particular occasion at 29 Palms, a SARGE operator teleoperated his RCMMP past a squad of Marines approximately 75 meters to his right without detecting the squad.

b. Recommendation. The 2-69 scouts recommended that both the day and night driving sensors on the TUV provide a panoramic view of the environment during remote driving operations to allow them to see well out to the front, right, left, and rear of the RCMMP to prevent missing threat vehicles and/or personnel.

2. Depth Perception

a. Discussion. The day and night driving sensors on the SARGE RCMMP do not provide depth perception to the operator. The lack of depth perception has two primary effects:

(1) It causes the operators to generally operate the RCMMP on well-defined roads, main trails, and secondary trails versus cross-country routes. This was especially true during night operations.

(2) It causes the operators to drive at very slow speeds (5 - 10 mphs) when traveling cross-country. The operators were cautious not to run into gullies, wadis, ditches, and especially barbed wire fences when moving cross-country. This was even more pronounced at night. At 29 Palms, one operator drove his RCMMP off an 18-foot drop-off into a wadi during daytime operations because he could not detect the severe drop-off.

b. Recommendation. To permit cross-country teleoperated mobility at an operationally useful speed, the objective TUV must be equipped with day and night remote driving cameras that provide the operator with depth perception of the terrain.

3. Day and Night Targeting Cameras

a. Discussion. The SARGE RCMMP is equipped with a 12 - 120mm zoom color camera for day target detection, and a 9-degree FOV FLIR for night target detection. The day and night targeting sensors proved to be effective out to a range of 2,000 - 2,500 meters. In the interviews and after action reviews, the scout platoon recommended that the objective TUV be equipped with day and night targeting sensors that will detect threat vehicular targets (moving and stationary) at a maximum range of 6 km and threat personnel targets (moving and stationary) at a maximum range of 3 km.

b. Recommendation. Based on their combined experience at the NTC and during Desert Shield/Storm, the scouts felt that target detection at these maximum ranges would allow them time to report targets, call for indirect fire on targets, and react to targets based upon available METT-T. This is particularly applicable to desert environments where target detection typically occurs at longer ranges. The scout platoon also recommended that the night targeting FLIR have a variable FOV, similar to the FLIR found on the BFV.

4. Global Positioning System/RCMMP Location

a. Discussion. The TUV User Appraisal SARGE RCMMP is equipped with a Motorola (COTS) GPS with an accuracy of 100 meters within the RCMMP's actual ground location. For the purposes of calling indirect fire missions, an accuracy of 100 meters did not prove to be adequate. Because the location of the RCMMP is used as a part of the call for fire solution by the firing artillery unit, this large an error in the RCMMP's location would result in the rounds being well off the intended target. Upon completion of the User Appraisal and to overcome this limitation, the SARGE systems were equipped with an AN/PSN-11 Precise

Lightweight Ground Receiver (PLGR) GPS to improve location accuracy. This more accurate RCMMP position should result in a marked improvement in the accuracy of indirect fires on threat targets.

b. Recommendation. The TUV RCMMP must have a GPS that provides an extremely accurate RCMMP ground position in order for the TUV system as a whole to provide accurate indirect fires on the targets it detects. (Every improvement reduces the error budget.)

5. RCMMP and STH Navigation

a. Discussion. The RCMMP and the STH are both equipped with an AN/PSN-11 PLGR GPS. The position of the RCMMP and the STH are displayed as icons on the OCU map display. As the RCMMP and the STH move, the icons on the OCU map display update to indicate the position of both platforms. The operator, by looking at his map screen, always knows his position at the OCU and the position of the RCMMP. The OCU status display also gives the operator the 10-digit grid coordinate of both the RCMMP and the STH. The ability of the operator to view the position of both the RCMMP and the STH on his OCU map display made navigation a fairly simple task. The TUV operator cannot be expected to navigate the RCMMP using a GPS fed map display and keep up with his location in a vehicle that moves using a standard 1:50,000 paper map and hand-held GPS.

b. Recommendation. The Objective TUV OCU must display the locations of the RCMMP and the vehicle carrying the OCU. If the OCU is emplaced in a ground mode, an icon on the OCU map display should also display the location of the OCU on the ground.

6. RCMMP "Quiet Mode" Battery Power

a. Discussion. When the RCMMP was remotely maneuvered into an observation post selected by the scout operator, it was placed in the "quiet mode." Essentially, the "quiet mode" means the RCMMP sits in place with its engine off and electronics on: cameras/sensors, radios, computer, and laser rangefinder. The SARGE RCMMP's 24-volt battery system would operate in the "quiet mode" for approximately 2 hours before the operator would have to start and run the engine for 15 to 20 minutes at a RPM high enough to recharge the batteries. This procedure was not ideal because the noise of the engine running at a high RPM would likely attract the attention of threat forces in the area.

b. Recommendation. The fielded TUV requires a "quiet mode" time approaching 12 to 18 hours and a method of recharging the batteries while occupying an observation post that will not violate observation post noise discipline. A method of recharging the RCMMP batteries at low RPMs should be investigated to prevent the operator from having to run the engine at high RPMs for recharging.

7. RCMMP Survivability

a. Discussion. During the TUV User Appraisal, the SARGE system was not equipped with a MILES, nor did it face a threat force equipped with MILES. The threat elements operating against the SARGE during the TUV User Appraisal were normally mounted or dismounted squad size elements without MILES. This made it difficult to collect any information on the survivability of the SARGE RCMMP. To correct this, the SARGE RCMMP is being outfitted with a MILES kit adapted from a HMMWV MILES kit. The STH will be outfitted with the standard HMMWV MILES kit. In future user appraisal events, every effort will be made to operate the SARGE RCMMP and STH against a challenging threat counter-reconnaissance force equipped with MILES.

b. Recommendation. The objective TUV RCMMP's sensor housing, computers, and radios will require some degree of protection against threat small arms fires and artillery/mortar fragments. Further survivability analysis will be required to make a more specific determination. Future User Appraisals should include the tactical employment of a MILES equipped SARGE system against a robust MILES equipped threat force.

8. Jamming

a. Discussion. A second consideration for survivability is jamming by threat radio frequency jamming systems. The SARGE system did not face threat jamming systems during the User Appraisal, but it can be expected that the objective TUV will be targeted for jamming once the threat becomes aware of its presence on the battlefield. The current SARGE system is being upgraded to include a 5 km fiber optic cable payout system. This provides the SARGE with a secure alternative to RF control during certain type missions. Also, the systems are being outfitted with directional versus omnidirectional antennas that will help reduce the potential of being located by threat RF detection systems.

b. Recommendation. It is recommended that the objective TUV have secure radios and directional antennas to help reduce the potential for location by threat RF detection systems. Additionally, it is recommended that the UGV/S JPO continue its investigation into a fiber optic cable payout system as an alternative, non-RF method of control for the TUV.

9. Teleoperation, RCMMP Navigation, and Semi-autonomous System Features

a. Discussion. Teleoperation, or the requirement for the operator to remotely drive the RCMMP using real-time video feedback at the OCU, is task intensive and tiring. When teleoperating, the operator's full attention must be kept on the video-driving screen. With the SARGE system, this is especially true because the system's driving cameras do not provide the operator with depth perception of the terrain. Thus, the operator must pay greater attention to avoid negative obstacles. If the operator is required to execute a task other than teleoperation, he must first stop the RCMMP, place it in neutral, and engage the parking brake.

(1) Navigation of the RCMMP is obviously important to the operator. To navigate the SARGE RCMMP, the operator is forced to glance between his video driving screen and his map display. In many cases, this is more than the operator can handle, especially when moving cross-country.

(2) The operator must also stop the RCMMP to conduct RSTA. When conducting RSTA with the SARGE, the operator must constantly manipulate the sensors using the joystick on the OCU to search a designated area for threat targets. Given that a RCMMP may occupy an observation post for 24 hours or longer, the requirement for an operator to manually search a designated sector for this amount of time is not realistic.

b. Recommendation. The incorporation of semi-autonomous and autonomous features into the fielded TUV is a definite requirement to reduce the task load of the operator. Some of these features may include:

Mobility

- Negative and positive obstacle detection and avoidance.

Targeting

- Automatic Target Detection/Recognition
- Automatic Sector Search (Ability for the operator to set the left and right limit of a sector with the RSTA payload automatically searching this sector)
- Automatic Camera/FLIR focus.

Navigation

- Pre-planned Route display (Display of best route based on mission planning). The icon of the RCMMP on the map display follows this route as the RCMMP moves and the GPS updates
- Destination icon and alert (Ability to place an icon on the map display for the RCMMP's final location and an audible or graphical alert to the operator that he is close to his final location)
- Off route alert (Audible or graphical alert if RCMMP strays too far off pre-planned route - Operator can turn this feature on or off)
- RCMMP Retro-Reverse (Ability of RCMMP to automatically retrace its route back to the operator or a pre-designated location (rally point)).

RCCMP Status

- Audible or graphical RCMMP status alerts (low fuel, hot engine, low oil, low battery power, etc).

10. TUV RCMMP Transportability

a. Discussion. The issue of how a non-mandriveable TUV RCMMP (a RCMMP without a seat for the operator to drive the RCMMP for short non-tactical moves) will be transported on the battlefield was brought to focus during User Appraisal. As stated in the TUV ORD, the fielded TUV must be integrated into receiving units without adding additional vehicles (other than the TUV RCMMP) or personnel. In the case of Army scout platoons, this means no additions to the platoon's 10 HMMWV and 30 personnel organization. The options available are to tow, trailer, or carry the RCMMP with the scout platoon's organic HMMWVs. The towing and carrying options were ruled out during discussion. Towing the RCMMP behind a HMMWV did not appear to be a reasonable solution. Although a subjective opinion, the 2-69 scouts did not feel it was feasible to tow an RCMMP behind a HMMWV and expect it to survive the pounding it would take, especially during cross-country operations. Carrying the RCMMP in a scout HMMWV was ruled out because a combat loaded scout HMMWV has no room to carry a TUV RCMMP. This left trailering the RCMMP behind the scout HMMWV as the only feasible option, with the OCU and its associated equipment integrated inside scout HMMWV.

b. Recommendation. If the objective TUV system consists of a non-mandriveable RCMMP, it is recommended that a trailer be provided to transport the RCMMP. A fully man-driveable RCMMP (a RCMMP that is driven by an operator until time to convert it to a TUV for unmanned operations) is an option that would delete the need for a trailer and provide more tactical flexibility.

11. Clearing Mud and Water from RCMMP Sensors

a. Discussion. During tactical operations at Ft. Benning, GA., the cameras and FLIRs on the RCMMP became covered with water and mud, obstructing the view of the operator at the OCU during teleoperation and RSTA.

b. Recommendation. It is recommended that the TUV operator, from the OCU, have the capability to clear water and/or mud off the surface of all the RCMMP's sensors or the housing containing the sensors.

XV. SUMMARY

The TUV User Appraisal Phase I achieved all its stated goals and objectives. Placing a prototype TUV in an armor battalion scout platoon for a 6-month appraisal enabled the UGV/S JPO to collect critical soldier feedback on TUV operational and system performance requirements; man-machine interface requirements; TUV tactical communication requirements; TUV mission planning hardware and software requirements; and TUV TTPs.

Key results of TUV User Appraisal Phase I are:

- Initial set of TUV TTPs developed
- Initial TUV operator manual developed
- Initial 5-day TUV training course developed
- Initial TUV Preventive Maintenance Checks and Services (PMCS) manual developed
- Operational performance requirements contained in TUV ORD validated and refined
- New TUV operational requirements developed and integrated into the TUV ORD
- TUV mission planning software developed
- TUV performance specification section covering mission planning developed based entirely on feedback from User Appraisal
- Over 40 percent of TUV performance specifications developed based on feedback from Use Appraisal
- Over 90 system performance, reliability, and maintainability changes made to the SARGE system.
- Based on feedback from the TUV User Appraisal Phase I, the UGV/S JPO initiated an effort in November 1997, to upgrade the SARGE system. The effort includes 22 upgrades to improve reliability, maintainability, and system operational performance on 4 SARGE systems. Two SARGE systems will be delivered to the UGV/S JPO in early May 1998, with two more systems to follow in early June 1998. The systems will undergo burn-in testing conducted by the UGV/S JPO's PATCM Division beginning in May 1998.

User Appraisal Phase I results were published in briefings and magazine articles, resulting in additional user interests. The UGV/S JPO will participate with SARGE systems in the United States Marine Corps Warfighting Laboratory's Battlefield Shaping Task Force Limited objective Experiment #2 (BSTF LOE # 2) 27 through 30 March 1998, and the Urban Warrior LOE #3,

19 through 24 July 1998. Additionally, the UGV/S JPO plans to participate in the Military Operations on Urban Terrain Advanced Concept Technology Demonstration (MOUT ACTD) in early FY 99.

The success of the User Appraisal is best summed up by reiterating the comments of the scout platoon to the ASB. In their interview with the ASB, the scouts endorsed the TUV concept and concluded that from their use of a prototype TUV, the TUV will increase the scout platoon's survivability, increase the number of areas it can be tasked to observe, expand the distance the platoon can conduct reconnaissance without concern for indirect fire support from its battalion, and increase the operational effectiveness of the battalion as a whole. The scout platoon also told the ASB that the Army and Marine Corps should continue efforts to develop and field the TUV.

INITIAL DISTRIBUTION LIST

		Copies
IIT Research Institute ATTN: GACIAC 10 W. 35th Street Chicago, IL 60616		1
AMSAM-RD,	Ms. Ellen Mahathey	1
AMSAM-RD-OB-R		5
AMSAM-RD-TI	(Tech Info)	1
AMSAM-L-G-I,	Mr. Fred Bush	1
AMSAM-DSA-UG,	Mr. Mike Harris	5